

SECTION 237316 – MODULAR AIR HANDLING UNITS

PART 1 - GENERAL

1.1. SUMMARY

- A. Section includes modular indoor and outdoor central-station air handling units.

1.2. SUBMITTALS

- A. Product Submittals: For each type of product indicated.
 - 1. Product Data: For each air-handling unit indicated, provide unit dimensions and weight; cabinet material, metal thickness, finishes, insulation, and accessories; certified fan-performance curves with system operating conditions indicated; certified fan-sound power ratings; fan construction and accessories; motor ratings, electrical characteristics, and motor accessories; certified coil-performance ratings with system operating conditions indicated; dampers including housings, linkages, and operators; and filters with performance characteristics.
 - 2. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved: mechanical-room layout and relationships between components and adjacent structural and mechanical elements; support location, type, and weight; and field measurements.
- B. Close-Out Submittals:
 - 1. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.3. QUALITY ASSURANCE

- A. Applicable components of the air handling units shall comply with:
 - 1. Fan Sound-Power Level Ratings: Comply with AMCA 300 and 301. Fans shall bear AMCA-certified sound ratings seal.
 - 2. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210.
 - 3. Water Coils: Factory tested to 300 psig according to AHRI 410 and ASHRAE 33.
 - 4. NFPA 70 (National Electric Code) and 90A
 - 5. AMCA 204, 205, 211 and 311
 - 6. AHRI 260, 261, 430 and 1060
 - 7. ASHRAE 62.1, Section 5 and 7
 - 8. ASHRAE/IESNA 90.1, Section 6
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.

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2. Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.
- C. Electrical Components, Devices and Accessories: UL listed and labeled as defined by NFPA 70, the National Electric Code, or equivalent by a qualified testing agency marked for the intended location and application and accepted by the Authority Having Jurisdiction and Engineer.
- D. Mechanical Equipment and Materials: UL listed and labeled as defined by State Building Codes or equivalent by a qualified testing agency marked for the intended location and application and accepted by the Authority Having Jurisdiction and Engineer.
- E. Testing and listing laboratories of mechanical and electrical equipment shall be accredited by the North Carolina Building Code Council (NCBCC).

1.4. COORDINATION

- A. Coordinate sizes, weights (operational and shipping) and locations of supports and opening with the actual equipment provided, including:
 1. Concrete bases
 2. Structural steel support members
 3. Roof curbs
 4. Roof/floor openings

1.5. EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: Two set(s) for each air-handling unit.
 2. Gaskets: One set for each access door.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 1. Carrier (39M indoor/outdoor series).
 2. Daikin/McQuay (Vision indoor / Skyline outdoor series).
 3. Trane Company (Performance Climate Changer indoor/outdoor series).

2.2. GENERAL REQUIREMENTS

- A. Refer to mechanical detail drawings for general arrangement elevation views of each air handling unit.

2.3. UNIT CASINGS

- A. Casing Fabrication: Factory-fabricated and constructed wall, roof and floor double-wall panels with 2-inch (R-13) closed-cell injected-foam or board insulation within formed galvanized steel channel framing. Provide stainless steel interior liner at all sections. Units shall be thermally broken to

minimize the conduction path from the inside of the casing to the outside. All joints shall be air-tight and water-resistant sealed.

1. Casing Performance:
 - a. Leakage: Casing shall meet AHRI 1350 Casing Air Leakage Rate CL3 with less than 10 cfm leakage per 100 sqft. at 6.0-inches w.g. positive or negative internal pressure.
 - b. Deflection: Casing shall meet AHRI 1350 Casing Deflection Rate CD3 with less than 0.0042-inches (1/240) deflection per inch of span at 6.0-inches positive or negative internal pressure. Floor deflection shall not exceed 0.0625-inches at 6-inches internal pressure and 300-pound per sqft. live load.
 2. Casing Materials: 18-gauge G90 galvanized steel exterior; 18-gauge stainless steel interior; and 18-gauge perforated stainless steel interior at fan sections.
 3. Casing Finish: Factory-applied prime-coat and thermosetting top-coat baked-on enamel.
 4. Casing Section Gaskets: Neoprene gasket around entire perimeter of casing section joints.
- B. Floor: Walking surfaces of floor panels shall have a solid 3/16-inch thick checker-plate aluminum solid lining with water-tight welded seams and reinforcements to support 300-pound per sqft. live load
1. Floor Openings: Floor openings shall be covered with removable aluminum or stainless steel grating to support 300-pound per sqft. live load.
- C. Roof: The roof of outdoor units shall be pitched at a minimum 1/2-inch to 12-inch slope to one side of the unit.
- D. Access Doors and Panels: Factory-fabricated double wall, to match casing and insulation materials, finish and performance and suitable for unit pressure and leakage classification. Doors shall open against positive pressure and be large enough to remove associated components such as motors, filters, etc. but no smaller than 24-inches wide and 60-inches tall. Additional access panels shall be provided to aid in removal of components such as fans, coils, etc.
1. Door Hinges, Latches and Handles: Minimum of two ball-bearing or piano hinges, two wedge-lever latches and steel quarter-turn handles.
 2. Door Gaskets: Neoprene gasket around entire perimeter of door frames.
 3. View Panels: In units sized for 10,000 CFM or more, provide 12-inch x 12-inch, double-glazed, wired-glass with an air space and rubber perimeter seals. View panels shall be located on the accessible side of the air handler in each fan section and coil access section doors.
- E. Condensate Drain Pans: Factory-fabricated, insulated stainless steel, water-tight sealed, minimum 2-inches deep drain pans sloped minimum 2-percent in two directions to comply with ASHRAE 62.1 and to collect condensate from cooling coils (including coil piping connections, coil headers and return bends) and humidifiers and direct water toward drain connection. Pan shall extend downstream of coil face to comply with ASHRAE 62.1. Drain connection shall be on the bottom side and at the lowest point on the pan. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.
- F. Base Rails: Structural steel channel rails continuous at the unit's perimeter and at intermediate locations needed to support internal components suitable for mounting on structural steel platform or concrete pad. Base rails be galvanized steel construction and outdoor unit base rails shall have an epoxy-based paint finish.
- G. Lifting and Handling Provisions: Factory-installed shipping skids and lifting lugs.

- H. Outdoor Unit Roof Curbs: Factory-fabricated, insulated, full-perimeter curb of sheet metal, minimum 14-inches high, with neoprene sealing strip, and welded Z-bar flashing. Fully insulate the internal perimeter of the curb with 2-inches (R-10) of polyisocyanurate board insulation. Insulation shall be mechanically fastened to the sheet metal. Comply with requirements in "The NRCA Roofing Manual."
- I. Intake and Discharge Hoods: Factory-fabricated, galvanized steel intake and discharge weather hoods with bird screen and finish to match unit casing.

2.4. FAN, DRIVE AND MOTOR SECTION

- A. Fans: Comply with requirements of Section 233400.
- B. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower. Shafts shall be designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.
- C. Fan Housings:
 - 1. Plenum Fan Housings: Direct-drive centrifugal type, steel frame and panel, fabricated without fan scroll and volute housing.
- D. Fan Wheels:
 - 1. Centrifugal Plenum Fan Wheels: Airfoil wheels shall be single-width single-inlet (SWSI) construction with heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. Fan Arrays: Direct-drive modular-plenum fans in a parallel array, using number of fans indicated but not less than 3, arranged to provide equal air flow across the unit's cross-section. The fans in each array shall be identical.
 - 1. Fan Vibration Isolation: Each fan shall be factory-mounted with neoprene pads.
 - 2. Fan Enclosures: Enclosure walls shall be constructed to reduce fan noise by minimum 6 dBA based on AMCA 301 ratings.
 - 3. Backdraft Dampers: Each fan shall have a factory-mounted motor-operated low-leakage backdraft damper that complies with the requirements of Section 233300. Pressure losses across the dampers shall be included in the fan performance data and not considered to be included in the unit's scheduled pressure drop.
 - 4. Variable Speed Drives: Comply with the requirements of Section 230514. Drives manufactured by the air handling unit manufacturer are also acceptable in addition to the manufacturers listed in Section 230514.
 - 5. Over-Speeding: Variable frequency drives shall not be set above 60 Hz.
 - a. Exceptions:
 - 1) Air Handling Units with Setback Schedules: Variable frequency drives shall not operate over 85 Hz and motors shall not operate over 3,000 RPM for direct-drive fans used in air handling units.
 - 6. Air Flow Measuring Stations: Differential pressure type piezometer ring mounted on the throat of the inlet cone. Accuracy shall be plus or minus 5 percent, including transducer and conversion error, at 100 to 5,000 fpm.
- F. Fan Shaft Bearings:

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1. Grease-Lubricated Bearings: Self-aligning, pillow-block-type, ball or roller bearings, L10 rated for 200,000 hours with adapter mount and two-piece, cast-iron housing with grease lines extended to outside unit.
- G. Internal Vibration Isolation: Fans shall be factory mounted with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
- H. Motors: Comply with requirements of Section 230513.
- I. Variable Frequency Controllers: Refer to Section 230514.
 1. Indoor Units: Mount variable speed drives on mechanical room walls, adjacent to the air handling unit where indicated on the drawings. Variable speed drives shall not be unit mounted.
 2. Outdoor Units: Mount variable speed drives within dedicated pre-manufactured casing compartment. Variable speed drives shall not be installed outdoors without supplemental cooling.
- J. Motor Starters and Disconnects: Refer to Section 230511.
 1. Where indicated to be unit-mounted, mount motor starters and disconnect switches on unit exterior per manufacture's recommendations.

2.5. COIL SECTION

- A. Heating and Cooling Coils: Provide coil types in positions indicated. Comply with requirements of Section 238216. Coils shall comply with ARI 410.
 1. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 2. Fabricate cooling coils with stainless steel frames.
 3. Coils shall not act as structural component of unit.
- B. Piping Enclosure: Hydronic coils in outdoor units shall come equipped with a factory-fabricated piping enclosure. The enclosure shall be constructed to match the unit casing materials and finish; match the unit height; be installed on a roof curb that encloses the piping roof penetrations; and have minimum 24-inch tall by 12-inch wide, hinged access doors on both sides to provide maintenance access to all valves and fittings.

2.6. MAINTENANCE ACCESS SECTION

- A. Maintenance Access Sections: Provide access sections as indicated in the documents; but not less than one 24-inch long section between coils unless otherwise noted. Each section shall be equipped with access doors on both sides of the unit.

2.7. AIR FILTRATION SECTION

- A. Filters: Filter sections shall be designed for the indicated filter types and orientations. Where not indicated, provide housings and frames for angled 2-inch deep filters.
- B. Filter Holding Frames: Provide filter holding frames arranged for flat or angled orientation, with access doors on both sides of unit. Filters shall be removable from either side.
 1. Panel Filters: Factory-fabricated galvanized steel filter holding frames arranged for flat or angular orientation as indicated, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

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- C. Filter Gage: Provide filter gage to measure pressure loss, 0 to 2-inches w.g., across each filter bank. Mount gages on unit casing directly above filter section access doors. Dwyer “Magnehelic” or equal.

2.8. MIXING BOX SECTIONS

- A. Mixing boxes shall be factory fabricated as a standard sectional component of the modular unit. Return, outdoor, and relief air dampers as specified, shall be installed in the factory fabricated mixing boxes. Damper linkages and motor operators shall be internal to the mixing box.

2.9. DAMPERS

- A. Leakage Rate: At a minimum, dampers leakage shall comply with AMCA Class I. Damper leakage rate shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential based on AMCA 500.
 - 1. Isolation Dampers: Refer to Section 233300.
- B. Damper Operators: Comply with requirements in Section 239000.
- C. Electronic Damper Operators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque. Electronic damper position indicator shall have visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
 - 1. Operator Motors: NEMA Premium Efficient motor, complying with Section 230513, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Permanent split-capacitor or shaded-pole type with gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 2. Non-spring-return motors for dampers larger than 25 sqft. shall be sized for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 3. Spring-return motors for dampers larger than 25 sqft. shall be sized for running and breakaway torque of 150 in. x lbf.
 - 4. Size dampers for running torque calculated as follows:
 - a. Parallel-blade dampers shall have running torque based on 7 inch-lb/sqft. of damper with edge seals and 4 inch-lb/sqft. of damper without edge seals.
 - b. Opposed-blade dampers shall have running torque based on 5 inch-lb/sqft. of damper with edge seals and 3 inch-lb/sqft. of damper without edge seals.
 - c. Increase running torque by 1.5 when dampers are exposed to 2 to 3-inches of pressure drop or 1000 to 2500 fpm face velocities. Increase running torque by 2.0 when dampers are exposed to 3 to 4-inches of pressure drop or 2500 to 3000 fpm face velocities.
 - 5. Coupling: V-bolt and V-shaped, toothed cradle.
 - 6. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 7. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on non-spring-return actuators.
 - 8. Power Requirements (Two-Position Spring Return): 24 V ac.
 - 9. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.

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10. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 11. Temperature Rating: Minus 22 to plus 122 deg F.
 12. Run Time: 12 seconds open and 5 seconds closed, unless otherwise indicated.
- D. Energy Recovery Face-and-Bypass Dampers: Opposed-blade, aluminum dampers with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single aluminum frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.
- E. Outdoor- and Return-Air Mixing Dampers: Aluminum dampers mechanically fastened to cadmium-plated steel operating rod in reinforced cabinet. Actuate dampers independently and simultaneously. Outdoor air dampers shall fail closed with spring return unless otherwise noted.
1. Outside Air (OA): Parallel blade type.
 2. Return Air (RA): Parallel blade type.

2.10. AIR-TO-AIR ENERGY RECOVERY

- A. Energy Recovery Section: Where indicated, provide energy recovery devices complying with Section 237200.

PART 3 - EXECUTION

3.1. DELIVERY

- A. All air handling unit openings shall be protected during shipping and rigging with sheet metal covers. The entire unit including each shipping section shall be wrapped in 7 mils plastic shrink wrap to maintain unit cleanliness.

3.2. EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for hydronic and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3. INSTALLATION

- A. Equipment Mounting:
1. Install indoor air-handling units on cast-in-place concrete equipment bases.
 2. Install outdoor air-handling units on roof curbs.
 3. Comply with requirements for vibration isolation and wind and seismic control devices specified in Section 230548.

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- B. Arrange installation of units to provide access space around air-handling units for service and maintenance. Coordinate unit locations and duct connections with structural elements such as roof trusses and floor joists.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.
- D. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.4. CONNECTIONS

- A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to air-handling unit to allow service and maintenance.
- C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.
- D. Connect condensate drain pans and extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Hot and Chilled Water Piping: Comply with applicable requirements in Sections 232113 and 232116. Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300.

3.5. FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6. STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - 5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 - 6. Verify that energy recovery module face-and-bypass dampers provide full face flow.

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7. Verify that outdoor- and return-air mixing dampers open and close and maintain minimum outdoor-air setting.
 8. Comb coil fins for parallel orientation.
 9. Install new, clean filters.
 10. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.
- B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 2. Measure and record motor electrical values for voltage and amperage.
 3. Manually operate dampers from fully closed to fully open position and record fan performance.
- 3.7. ADJUSTING
- A. Adjust damper linkages for proper damper operation.
 - B. Comply with requirements in Section 230593 for air-handling system testing, adjusting, and balancing.
 - C. Coordinate various adjustments with the TAB Contractor including fan speed/airflow adjustments and damper operation/setpoint requirements.
- 3.8. CLEANING
- A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units inside and out. Remove internal foreign materials, construction dirt, and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.
- 3.9. DEMONSTRATION
- A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 237316